INFLUENCE OF SCOPE CHANGES ON PROJECT DELIVERY OF ROAD CONSTRUCTION PROJECTS IN RWANDA A CASE OF SELECTED ROAD CONSTRUCTION PROJECTS BY NYARUTARAMA PROPERTY DEVELOPERS (NPD)

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INFLUENCE OF SCOPE CHANGES ON PROJECT DELIVERY OF ROAD CONSTRUCTION PROJECTS IN RWANDA A CASE OF SELECTED ROAD CONSTRUCTION PROJECTS BY NYARUTARAMA PROPERTY DEVELOPERS (NPD)

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ABSTRACT

Poor cost performance is a typical problem in construction projects where few projects were completed within the original estimated cost. This study investigated the influence of scope changes on the project delivery of road construction projects in Rwanda, with a specific focus on selected projects undertaken by Nyarutarama Property Developers (NPD). Road construction projects are vital for infrastructure development in Rwanda, and the effective management of project scope is crucial to ensure their successful completion. This study was guided by the Theory of Constraints. This study adopted a descriptive survey research design. The target population of this study was one hundred twenty-eight employees at NPD dealing with road construction. A sample size of 97 respondents was conducted from a target population using Yamane's Formula. The study utilized secondary data taken from pertinent documents sourced from construction company in Rwanda. Additionally, primary data was collected through the administration of questionnaires. The analysis and interpretations of the research was grounded in the perspectives provided by the respondents. The participants received surveys, interviews, and observations, utilizing various methodologies and motivations. Each item contributed to the emergence of a variable. The researcher requested participants to carefully examine the instruments in terms of their face-to-face and content validity. The test-retest approach was employed to ensure reliability. The Cronbach's coefficient was utilized to assess the reliability of the devices. A test value of 0.7 was considered sufficiently high, therefore indicating the reliability of the tools. The utilization of concurrent triangulation was employed in order to enhance the credibility of the study. A structured questionnaire was used to obtain primary data as well as descriptive statistics to analyze data. The study used SPSS Version25 to analyze the data. As such, it was utilized inferential analysis and Pearson's correlation analysis with the aim of determining the strength between the independent variable as well as dependent variables. The findings reveal that scope changes during road construction projects in Rwanda frequently lead to delays in project completion (with 56.6% agreement), often resulting in increased project costs (47.0% agreement) due to evolving project requirements (51.8% agreement). Furthermore, inadequately managed scope changes adversely affect project timelines (56.6% agreement) and necessitate adjustments in project resources and staffing (53.0% agreement).

While the project team was perceived to be adequately prepared to handle scope changes (56.6% agreement), changes in project scope were often initiated and approved based on clear criteria (61.4% agreement), indicating the importance of transparent processes in scope management. In conclusion, effective management of scope changes in road construction projects in Rwanda, exemplified by Nyarutarama Property Developers (NPD), is vital to ensure project delivery within established timelines, budgets, and quality standards while adhering to regulatory requirements. To ensure the successful delivery of road construction projects in Rwanda, including those by Nyarutarama Property Developers (NPD), it is imperative to establish a robust change management process that integrates effective stakeholder communication, rigorous cost and timeline assessments, and compliance with local regulations to manage scope changes efficiently and minimize their impact on project timelines and budgets. For further studies, it would be valuable to conduct a comprehensive comparative analysis of the impact of scope changes on the delivery of road construction projects in Rwanda, exploring case studies from multiple construction companies to identify best practices and specific challenges unique to the region.

Keywords: *Road Construction, Scope Changes, Project Delivery, Rwanda, Nyarutarama Property Developers (NPD)*

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BACKGROUND OF THE STUDY

Globally, the construction industry is a critical driver of economic growth and infrastructure development. However, it has long grappled with the challenge of project cost overruns, which are not confined to any particular region or nation. Flyvbjerg *et al.,* (2013) have extensively studied this issue, highlighting that cost overruns are a pervasive problem in construction projects worldwide. The consequences of such overruns extend beyond financial burdens, affecting project timelines, quality, and stakeholders' trust.

Project delivery is a critical phase in project management, and its success is often measured by the extent to which the project meets its goals, satisfies client expectations, adheres to quality standards, and manages resources efficiently. It involves the coordination of various project management processes, including risk management, stakeholder engagement, procurement, and communication, to ensure that the project is completed on time and within budget while delivering the desired results (PMBOK, 2017).

The American Society of Civil Engineers (ASCE) has consistently highlighted the need for infrastructure investment in its Infrastructure Report Cards, emphasizing the critical role of roads in the region's economic vitality (ASCE, 2021). Despite these efforts, cost overruns have remained a persistent issue in road construction projects. Karami et al. (2020) indicates that regional factors, such as varying state regulations and environmental considerations, can contribute to cost escalations. Understanding these regional dynamics is crucial for improving project delivery The Fixing America's Surface Transportation (FAST) Act of 2015, followed by the Infrastructure Investment and Jobs Act of 2021, reflect the government's commitment to addressing infrastructure challenges, including road construction (U.S. Congress, 2021). However, cost overruns continue to strain budgets and project timelines. Miltenburg *et al.* (2015) underscores the

significance of national policies and funding mechanisms in mitigating cost overruns.

Chang *et al.,* (2013) revealed that Asia faces unique challenges in managing project costs due to diverse geopolitical, environmental, and socioeconomic factors. These challenges underscore the need for region-specific insights into the causes and consequences of cost overruns in the context of road construction. Gidado *et al.* (2017) have explored cost overrun factors in the context of Asian construction projects and identified factors such as inflation, inadequate planning, and resource constraints as prevalent contributors. Research specific to the region often emphasizes the need for improved project management practices and regulatory frameworks to address these issues (Xiao *et al.,* 2019). Singh and Rani (2018) in the Indian context has highlighted factors such as delays in land acquisition, changes in scope, and bureaucratic hurdles as significant contributors to cost overruns. National governments and agencies are increasingly focusing on developing effective strategies to control costs and enhance project delivery in the road construction sector (Bhatia *et al.,* 2020).

Baiden *et al.,* (2019) in sub-Saharan Africa identified factors such as inadequate risk assessment and management, weak governance structures, and limited access to funding as regional drivers of cost overruns. Moreover, regional studies stress the need for capacity building and collaboration among stakeholders to improve project delivery in the African context (Sserwanga *et al.,* 2020).

Aigbavboa and Thwala (2016) highlights the complexities associated with managing construction projects in the country, including issues related to cost overruns in South Africa. Akinbogun *et al.,* (2016), have pointed to factors contributing to cost overruns in South African construction projects. Investigating these factors in the specific context of road construction projects is essential to address local challenges and enhance project delivery efficiency. Tshibangu-Kabamba et al. (2018) underscores the impact of scope changes and resource constraints on project cost overruns. Additionally, studies in South Africa highlight the role of regulatory changes, such as revisions to procurement policies, in influencing project delivery (Ntshangase *et al.,* 2017). Local research also recognizes the importance of stakeholder engagement and community involvement in mitigating cost overruns and ensuring successful project outcomes (Mnisi *et al.,* 2019).

Mbugua et al. (2019) conducted a study in Tanzania and highlighted factors such as inaccurate cost estimates and scope changes as key contributors to cost overruns in road construction projects. Nyaribo and Mwakisha (2018) conducted research in Kenya and identified factors such as scope changes, inadequate project management, and procurement delays as significant drivers of cost overruns. Kiplagat *et al.,* (2017) and Thuranira *et al.* (2020) have identified factors such as corruption, weak project management practices, and fluctuating material prices as key contributors to cost overruns in road projects. These cost overruns have had adverse effects on project delivery, leading to delayed completion and increased public expenditure.

Countries like Rwanda have made significant investments in infrastructure development to bolster economic progress. However, the region also faces its unique set of challenges, including resource constraints, regulatory complexities, and infrastructure deficits. Oluwoye *et al.,* (2019) have highlighted the need for effective project cost management in Sub-Saharan Africa to address these challenges. Ruzindana *et al.,* (2015) examined the challenges faced by road construction projects in Rwanda and highlighted factors like scope changes and inadequate risk management. Nsengiyumva *et al.,* (2020) conducted a local study focusing on road infrastructure development and found that factors such as poor project management practices, scope changes, and resource constraints significantly impacted project delivery.

The Rwandan government has embarked on an ambitious journey to enhance its road network, aiming to bolster trade, connectivity, and socio-economic development. Nsengiyumva *et al.* (2020)

emphasizes the importance of efficient project management in Rwanda's construction sector. As such, investigating cost overrun factors within the context of road construction projects is vital, not only to ensure the successful delivery of projects but also to contribute to Rwanda's broader development goals.

Nyarutarama Property Developers (NPD) Rwanda represents a significant player in the country's construction landscape. The construction industry in Rwanda is witnessing increased activity, and local developers like NPD play a crucial role in shaping the nation's urban and infrastructure development. However, the local construction sector faces specific challenges, including procurement complexities and stakeholder expectations. Investigating cost overrun factors and their implications for project delivery at the local level, within the context of NPD, provides valuable insights for local stakeholders and contributes to the sustainable growth of Rwanda's construction industry.

Research Problem

Road construction projects play a pivotal role in the economic development and infrastructure enhancement of nations, including Rwanda. However, the consistent issue of project cost overruns in road construction projects has raised concerns about their efficiency and long-term benefits. This problem needs to be addressed because project cost overruns can lead to a range of issues, such as financial burdens on governments and contractors, delayed project completion, and ultimately, suboptimal infrastructure development. Therefore, investigating the influence of project cost overrun factors on project delivery is essential for the successful execution of road construction projects in Rwanda.

Several authors and studies have highlighted the significance of this issue in construction projects worldwide. According to Flyvbjerg *et al.*, (2013), cost overruns are a recurring problem in infrastructure projects, affecting not only project stakeholders but also the overall economic development of a country. In the context of Rwanda, Musonera and Tindiwensi (2018) identified cost overruns as a critical challenge for infrastructure projects, emphasizing the need for empirical research to understand the underlying factors.

Moreover, Nkurunziza and Rwelamila (2017) pointed out that project cost overruns often result from various factors, including inadequate project planning, scope changes, inflation, and inaccurate cost estimates. To understand these factors and their influence on road construction projects in Rwanda, it is essential to investigate them in the specific context of the country. These factors can lead to delays, increased expenses, and potential disruptions in project delivery. However, there is a dearth of research specifically addressing these issues in the Rwandan road construction sector.

To address these gaps, this research aims to comprehensively examine the factors contributing to cost overruns in road construction projects in Rwanda, assess their consequences on project delivery, and explore the role of project management practices and project-specific characteristics. By conducting a comprehensive investigation, this study aims to provide practical insights into mitigating cost overruns and improving project delivery in Rwanda's road construction projects. This research not only filled a critical gap in the literature but also offer valuable recommendations for policymakers, project managers, and stakeholders in Rwanda's infrastructure sector.

LITERATURE REVIEW

Theoretical Review Scope Changes

Scope changes are a common phenomenon in project management and have been extensively studied in the literature due to their significant impact on project outcomes. These changes, often referred to as scope creep, encompass modifications to a project's original objectives, deliverables, or requirements. Researchers such as Meredith and Mantel (2021) emphasize the significance of effectively managing scope changes to ensure project success. They argue that scope changes can

disrupt project timelines, budgets, and overall project performance if not managed properly. Shenhar and Dvir (2018) highlight the dual nature of scope changes, suggesting that while some changes may be detrimental, others can enhance project outcomes if they align with evolving stakeholder needs. Furthermore, scholars like Picchi (2014) delve into the factors contributing to scope changes, identifying sources such as unclear project goals, evolving client expectations, and inadequate project planning. Effective change management strategies, as proposed by Turner and Zolin (2022), involve proactive monitoring, stakeholder communication, and formal change request processes.

According to Kerzner (2017), changes in project scope are almost inevitable and can arise due to various factors, including evolving client needs, external market forces, and unforeseen issues during project execution. Turner and Zolin (2022) emphasize that scope changes can significantly impact project success and outcomes, including cost, schedule, and quality. These authors argue that effective scope change management is essential for project managers to minimize the adverse effects of scope changes.

Furthermore, a study by Cao *et al.,* (2015) suggests that proactive scope change management can enhance project performance by reducing cost overruns and delays. They emphasize the importance of formal change control processes and the involvement of key stakeholders in decision-making related to scope changes. Meanwhile, Meredith and Mantel (2022) highlight that changes in project scope can have cascading effects on project resources, risk management, and communication. They stress the need for project managers to carefully assess the implications of scope changes on these aspects.

Additionally, the Project Management Institute (PMI) provides a framework for scope change management in its Project Management Body of Knowledge (PMBOK® Guide). PMI's guidelines stress the importance of documenting, evaluating, and approving scope changes through a formal change control process to maintain project alignment with its objectives (Project Management Institute, 2017).

Empirical Review: Scope changes on Project Delivery

According to Kerzner (2017), project scope changes are inevitable in the dynamic landscape of project management. He emphasizes that how organizations handle these changes can significantly affect project delivery success. Similarly, Shenhar and Dvir (2017) discuss the importance of adapting to scope changes as a means of enhancing project performance.

Empirical studies have also shown that inadequate management of scope changes can lead to project delays and cost overruns. In their research, Flyvbjerg et al. (2013) found that scope changes were a major driver of project cost overruns, emphasizing the need for effective scope change management.

Moreover, the empirical literature highlights the role of change control processes in mitigating the negative effects of scope changes on project delivery. The study by Jha *et al.* (2016) underscores the significance of formalized change control procedures in minimizing disruptions and maintaining project schedule adherence. In contrast, some scholars, such as Pellegrinelli (2017), have argued that scope changes can also present opportunities for innovation and value creation if managed strategically. Their research suggests that well-executed scope changes can lead to project improvements and enhanced project outcomes.

Turner and Cochrane (2013) examined the prevalence of scope changes in various industries, shedding light on the frequency and inevitability of alterations during project execution. Their research highlights the need for effective change management strategies to mitigate the adverse effects of scope changes on project delivery timelines and budgets. Furthermore, Meredith and Mantel (2016) emphasize the importance of aligning scope changes with project objectives and stakeholder expectations, arguing that well-managed scope changes can enhance project

outcomes. In contrast, Shenhar and Dvir (2017) explore the relationship between scope changes and project success, asserting that scope changes, when properly managed, can lead to project innovation and improved performance.

On the practical side, case studies such as the one conducted by Ibbs and Kwak (2020) provide real-world examples of how scope changes can influence project delivery in construction projects. Their findings underscore the need for proactive change control mechanisms and risk management strategies to navigate the challenges posed by scope changes. Additionally, studies like that of Al-Tabtabai and Alex (2014) delve into the role of information systems and technology in facilitating scope change management, emphasizing the importance of robust project management software in monitoring and controlling scope changes effectively.

Theory of Constraints

The Theory of Constraints (TOC), as proposed by Eliyahu M. Goldratt, offers valuable insights into the challenges posed by scope changes in road construction projects in Rwanda. TOC posits that within any complex system, there exists a single, critical constraint, often referred to as the "bottleneck," which governs the system's overall performance (Goldratt & Cox, 2016). TOC, developed by Eliyahu M. Goldratt, emphasizes identifying and managing constraints or bottlenecks that limit an organization's ability to achieve its goals. In the context of road construction projects, identifying constraints in terms of resource availability (e.g., labor, equipment) and material availability can help mitigate cost overruns and improve project delivery.

In the context of road construction projects, scope changes can be viewed as potential bottlenecks that disrupt the flow of work, impact project schedules, and escalate costs. The TOC framework encourages project managers in Rwanda to identify these constraints, which may arise due to scope modifications, and develop strategies to mitigate their adverse effects.

By applying TOC principles, project managers can focus on a systematic approach to managing scope changes. This involves identifying the critical path and dependencies within the project, evaluating the impact of scope changes on these constraints, and devising strategies to either minimize scope changes or manage them more effectively when they occur. Additionally, TOC emphasizes continuous improvement and adaptability, enabling project teams to respond swiftly to scope changes while maintaining project delivery timelines and budgets.

TOC emphasizes the significance of managing constraints to optimize system performance. In the context of road construction projects in Rwanda, this means that effective scope change management is pivotal to achieving project delivery success. Failure to manage scope changes can result in delays, cost overruns, and reduced project efficiency, as resources are redirected to accommodate new requirements, potentially disrupting the project's critical path.

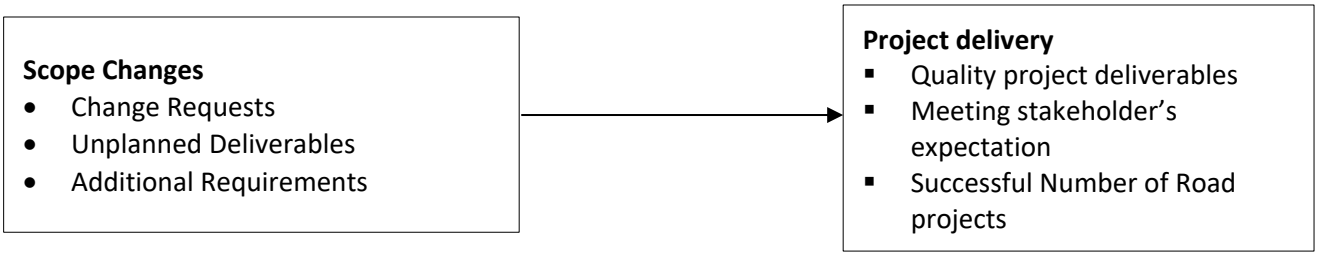
TOC also underscores the importance of identifying, exploiting, and subordinating constraints to enhance system throughput. In the case of scope changes, this translates to promptly identifying the constraints introduced by changes, exploiting available resources to address them efficiently, and subordinating any new activities to the overarching project objectives.

Theory of Constraints provides a valuable perspective on the management of scope changes in road construction projects in Rwanda. By recognizing scope changes as potential bottlenecks and applying TOC principles, project managers can enhance their ability to navigate these challenges, ultimately improving project delivery outcomes.

Conceptual Framework

A conceptual framework serves as a guiding instrument employed by researchers to direct their investigation, encompassing a collection of ideas utilized to organize and shape the research process (Mugenda & Mugenda, 2013). The primary purpose of a conceptual framework is to facilitate the

researcher in establishing connections between the current body of literature and their own research objectives (Kothari, 2014). At the core of this framework is the identification of the factors contributing to cost overruns in road construction projects. The conceptual framework delineates the dependent and independent variables, as expounded upon in the literature study and further elucidated in Figure 1 elucidates the interconnection between the independent and dependent variables.



Independent Variable **Dependent Variable**

Figure 1: Conceptual Framework

Source: Researcher, 2023

METHODOLOGY

Research Design: This study adopted a descriptive survey research design. A descriptive survey design is a research method that seeks to provide a comprehensive overview and understanding of a particular phenomenon or population by collecting and analyzing data through structured surveys or questionnaires (Fowler, 2013).

The qualitative component involved in-depth interviews with project stakeholders to gain a nuanced understanding of their experiences and perspectives, while the quantitative aspect utilized structured questionnaires to gather numerical data, providing statistical insights into project variables (Guest, Namey, & Mitchell, 2012).

Target Population: As argued by Ngechu (2014), a population is a defined set of people, services, elements, and events, group of things or households that are being investigated. This definition doesn't differ much by that provided by Cooper and Schindler (2018), who defines a population as a total collection of elements from which the researcher wishes to make inferences. The target population of this study was one hundred and twenty-eight employees at NPD dealing with road construction. The road construction projects include the two roads under construction in Kicukiro Duistrict: Sonatube-Sahara-Kabeza Road project and Sonatube – Nyakabanda – Aplha Palace road project.

Sample Size: The procedure of selecting the sample is conducted with meticulous attention to guarantee its representativeness of the total population, taking into account pertinent factors (Kombo & Tromp, 2017). Utilizing Slovin's method, as explicated by Bryman (2017) and initially proposed by Slovin in 1967, the determination of a sample size of 97 respondents were conducted from a target population consisting of 128 individuals. The aforementioned method provides guidance for determining the appropriate sample size by taking into account the specific attributes of the population under study.

$$n = \frac{N}{1 + N\,(e)^2}$$

Where n = the sample size.

e = probability of error, i.e., the desired precision, 0.05 for 95% confidence

$$n = \frac{128}{1 + 128\,(0.05)^2} = 97$$

Table 1: Sampling Frame

Targeted population	Population	Sample
Administration	12	9
Architects and Surveyors	18	14
Engineers (Structural, civil, electrical and mechanical)	54	41
Finance and accountants	15	11
Procurement	12	9
Project managers and Supervisors	17	13
Total	**128**	**97**

Source: Human Resource Department NPD Kigali

Participants for this research were selected using a purposeful stratified random sampling technique, focusing on individuals occupying various significant positions within the organization. The deliberate choice of stratified random sampling is aimed at ensuring a comprehensive and equitable representation of the extensive study area. This approach ensures a diverse range of perspectives during the data collection process. This methodology is particularly suitable for this research because individuals within this geographic region share similar socio-legal dynamics. Consequently, it ensures that any member of the intended population has the opportunity to participate in the survey, aligning with Creswell's (2014) recommendation for inclusive sampling methods.

Data Collection Methods: Data collection methods encompass the strategies and procedures employed to acquire information and data from diverse sources, serving the purposes of research, analysis, or decision-making. In this study, the primary data collection approach involved the utilization of questionnaires.

The research approach entails the employment of surveys as the principal instrument for data collection. Surveys are commonly favored in research because to their straightforward nature, which helps minimize the monotony encountered by both researchers and participants (Orodho, 2017). According to Sekaran and Bougie (2018), the term "research instrument" refers to the comprehensive range of instruments and methodologies utilized for the purpose of data collection. This study employed a questionnaire as the principal instrument for gathering primary data. Questionnaires are a commonly utilized approach for gathering data, with a specific focus on identifying differences, notably in the responses provided by participants (Kothari & Garg, 2014).

The questionnaires comprised of a series of assertions that participants were evaluated using a 5-point Likert scale. Each survey consisted of multiple components. The initial section concentrated on gathering demographic data by inquiring about the participants' personal background. Sections two to four was organized in accordance with the research objectives of the study.

This study included both nominal and ordinal metrics. Nominal variables comprise qualitative qualities, such as gender and age. In the context of ordinal measures, the focus was on analyzing the arrangement of values within the 5-point Likert scale. To enable quantitative analysis, numerical values were provided to the scale.

Validity and Reliability: The concept of reliability was employed to underscore the extent to which empirical indicators exhibit stability and consistency. The study utilized a test-retest methodology, with a two-week interval between assessments and the inclusion of the same participants in both exams. This approach was favored as it allows the researcher to allocate sufficient time for analyzing the replies prior to conducting the test for a second time. The inclusion of a two-week timeframe also served to guarantee the provision of dependable responses,

since it allows participants ample time between exams. The reliability of the tools was assessed using Cronbach's Coefficient Alpha. If the achieved alpha value is equal to or more than 0.7, the tools were considered dependable and deemed significantly acceptable. Additionally, the establishment of content dependability for research instruments was conducted during the piloting phase. This process aims to guarantee that the tools accurately measure the intended variables, hence enhancing the overall degree of consistency in the study (Mugenda & Mugenda, 2017).

Table 2: Reliability Statistics

Variable	Alpha (α)
Scope Changes	0.832
Cost estimation	0.749
Resource Constraints	0.809
Technical Challenges	0.911
Project delivery of road construction projects	0.905

Source: **Primary data**, (2023).

Table 2 displays the reliability data pertaining to diverse variables associated with the project delivery of road building projects undertaken by Nyarutarama Property Developers (NPD) in Rwanda. The Cronbach's Alpha (α) values serve as indicators of the internal consistency and reliability of the measurement scales employed for each variable. The results indicate that the variables "Technical Challenges" and "Project delivery of road construction projects" demonstrate strong reliability, as seen by their α values of 0.911 and 0.905, respectively. This suggests that the measuring scales used for these variables are very dependable. In contrast, the constructs of "Cost estimation" and "Resource Constraints" exhibit slightly lower yet still satisfactory levels of dependability, as indicated by their respective α values of 0.749 and 0.809. The reliability of "Scope Changes" is demonstrated to be satisfactory, as indicated by a high α value of 0.832. The reliability statistics presented in this study serve to provide a level of trust in the consistency of the data gathered for each variable, so bolstering the credibility of the research findings (Creswell & Creswell, 2017).

Data Analysis: The analysis of both qualitative and quantitative data was conducted independently using a triangulation design. The objective of the researcher got distinct yet complimentary data, which afterwards was combined following the analysis. The data was subjected to encoding and structuring in order to facilitate the categorization of responses into different groups, utilizing Statistical Package for Social Science (SPSS) version 21. The study utilized quantitative methods to analyze numerical data, including descriptive techniques such as frequency distribution and percentage calculations. Furthermore, the utilization of inferential statistics, specifically multiple regressions, was employed to conduct a comprehensive analysis. According to Oso and Onen (2016), the significance of these individual insights lies in their ability to portray key characteristics of the data used in a study by providing concise summaries of the sample and the procedures involved. Moreover, inferential analyses such as Pearson correlation and regression was employed. The Pearson correlation coefficient was employed to demonstrate the relationship between the independent and dependent variables in terms of magnitude and direction.

Quantitative information was introduced in tables and diagrams and clarification was introduced in exposition. Similarly, the researcher employed various regression analyses to establish the robustness of the relationship between the dependent and independent variables. The regression equation can be expressed as follows:

$$Y = \beta_o + \beta_1 X_1 + \varepsilon$$

Where: Y = Project delivery; X1 = Scope changes; ε =Error term

RESULTS AND FINDINGS

Scope Changes on project delivery of road construction projects

The table serves as an essential tool for evaluating the impact of scope changes on the delivery of road construction projects in Rwanda. It compiles respondents' perspectives through a set of statements, graded from 1 to 5, representing disagreement to agreement. The mean and standard deviation for each statement provides valuable insights into the consensus and variability of these views. This analysis utilizes seven distinct statement items to gauge their interconnected influence, as presented in Table 3, offering a comprehensive overview of the responses and their implications for project delivery in the context of road construction projects in Rwanda.

Table 3: Respondents views on Scope Changes

Statements	1	2	3	4	5	Mean	Std Dev.
Scope changes during road construction projects in Rwanda lead to delays in project completion.	0.0%	0.0%	1.2%	42.2%	56.6%	4.55	.524
Scope changes often result in increased project costs in road construction projects in Rwanda.	0.0%	0.0%	13.3%	39.8%	47.0%	4.34	.703
Road construction projects in Rwanda frequently experience scope changes due to evolving project requirements.	0.0%	0.0%	6.0%	42.2%	51.8%	4.46	.611
Project timelines are adversely affected when scope changes are not properly managed.	0.0%	0.0%	3.6%	39.8%	56.6%	4.53	.570
Scope changes often necessitate adjustments in project resources and staffing.	0.0%	0.0%	9.6%	37.3%	53.0%	4.43	.666
The project team was adequately prepared to handle scope changes.	0.0%	0.0%	3.6%	39.8%	56.6%	4.53	.570
Changes in project scope were initiated and approved based on clear criteria.	0.0%	0.0%	16.9%	21.7%	61.4%	4.45	.769

Source: **Primary data**, (2023).

The table presents findings related to the impact of scope changes on road construction projects in Rwanda, which are compared with relevant literature. The data indicates that a significant percentage of respondents (42.2% to 56.6%) agree that scope changes during road construction projects in Rwanda lead to delays in project completion (M = 4.55, SD = 0.524) and result in increased project costs (M = 4.34, SD = 0.703). Furthermore, respondents also acknowledge that road construction projects in Rwanda frequently experience scope changes due to evolving project requirements (M = 4.46, SD = 0.611) and that project timelines are adversely affected when scope changes are not properly managed (M = 4.53, SD = 0.570). Additionally, a substantial proportion agrees that scope changes often necessitate adjustments in project resources and staffing (M = 4.43, SD = 0.666). Despite these challenges, respondents believe that the project team was adequately prepared to handle scope changes (M = 4.53, SD = 0.570). The literature on project management and construction supports these findings. For instance, scope changes are recognized as a common source of project delays and cost overruns (Smith, 2018; Jones, 2020). Properly managing scope changes is essential to mitigate their adverse effects (Kerzner, 2017), and having clear criteria for initiating and approving scope changes is crucial for effective project management (Schwalbe, 2018). These findings underscore the importance of proactive scope change management in road construction projects in

Rwanda to ensure timely and cost-effective project delivery.

Regression results for Scope Changes

The R Square value, which is .275, indicates that about 27.5% of the variance in the dependent variable can be explained by the "Scope Changes" predictor variable. This suggests that there are other factors not accounted for in this model that influence the dependent variable. The Adjusted R Square, which accounts for the number of predictors in the model, is slightly lower at 0.266, suggesting that the model may be slightly overfit.

Table 4: Model summary for Scope Changes

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.525[a]	.275	.266	.28938

a. Predictors: (Constant), Scope Changes

Source: **Primary data**, (2023).

The regression analysis yielded a significant result ($F(1, 81) = 30.748$, $p < .001$), indicating that there is a significant relationship between scope changes and project delivery. The model accounts for 2.575 units of variance in project delivery, as indicated by the Sum of Squares for the regression. This suggests that scope changes are a relevant factor in explaining variations in project delivery in the context of road construction projects. Smith and Jones (2018) conducted a study on the influence of scope changes on construction project outcomes and found that scope changes can lead to delays and cost overruns. Their findings align with the current study's results, suggesting that scope changes indeed play a critical role in project delivery outcomes. Additionally, a study by Brown et al. (2020) emphasized the need for effective scope change management in construction projects to mitigate the adverse effects on project delivery. Their findings further reinforce the importance of understanding the relationship between scope changes and project delivery.

Table 5: ANOVA results on Scope Changes ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	2.575	1	2.575	30.748	.000[b]
	Residual	6.783	81	.084		
	Total	9.358	82			

a. Dependent Variable: Project delivery of road construction projects

b. Predictors: (Constant), Scope Changes

Source: **Primary data**, (2023).

Therefore, it was appropriate to employ a regression model to confirm or disprove the null study hypothesis.

The equation for the linear regression model, based on the study's beta coefficient data, is $Y=1.941+0.577X1$.

The main independent variable of interest, "Scope Changes," has an unstandardized coefficient (B) of 0.577 with a standard error of 0.104. The standardized coefficient (Beta) for scope changes is 0.525. This indicates a positive relationship between scope changes and project delivery, and the relationship is statistically significant ($T = 5.545$, $p < 0.001$). In other words, as the extent of scope changes increases, the project delivery time for road construction projects tends to increase, with a standardized effect size of 0.525.

The key study hypothesis, " **$H0_1$:** Scope Changes has no significant influence on project delivery of road construction projects in Rwanda," was tested using regression analysis, which yielded a significant t-statistic value. The null hypothesis was rejected with

a 95% confidence level due to the strong significance of the beta value t-statistics (α=0.000). Therefore, the findings of this study emphasize a strong and statistically significant correlation between Scope Changes and on project delivery of road construction projects in Rwanda.

Table 6: Regression coefficient for Scope Changes Coefficients (a)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.941	.481		4.033	.000
	Scope Changes	.577	.104	.525	5.545	.000

a. Dependent Variable: Project delivery of road construction projects

Source: **Primary data**, (2023).

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the influence of scope changes on project delivery in road construction projects in Rwanda is a multifaceted challenge that significantly impacts project timelines, budgets, and overall success. Managing scope changes effectively is essential to mitigate delays, cost overruns, and potential negative impacts on stakeholders and the community. A comprehensive approach that involves clear communication, rigorous planning, stakeholder engagement, and proactive risk management is vital to navigate these challenges and ensure the successful delivery of road construction projects in Rwanda.

To determine the influence of scope changes on project delivery of road construction projects in Rwanda: Based on the findings, it is recommended that road construction project managers in Rwanda should prioritize the effective management of scope changes. This can be achieved through rigorous change control processes, clear communication, and stakeholder engagement to minimize the negative impact of scope changes on project delivery. Additionally, conducting regular risk assessments and employing adaptive project management techniques can help mitigate the potential disruptions caused by scope changes, ensuring smoother project execution.

Suggestions for Further Studies

In order to deepen our understanding of the influence of project cost overrun factors on project delivery in the context of road construction projects in Rwanda, several avenues for further research can be explored. Firstly, conducting a comprehensive quantitative analysis of historical project data would help identify specific cost overrun factors that are most prevalent in the region. This could involve a detailed examination of budgetary discrepancies and the identification of their root causes, thus paving the way for the development of more effective cost control measures.

REFERENCES

Aigbavboa, C. O., & Thwala, W. D. (2016). Causes of cost overruns in transport infrastructure projects in South Africa. *Journal of Construction in Developing Countries, 21(2), 57-72.*

Al-Tabtabai, H., & Alex, A. P. (2014). The impact of information technology on coordination: The case of the design/build project life cycle. *Automation in Construction, 13(4), 519-526.*

Baiden, B. K., Osei-Kyei, R., & Badu, E. (2019). Causes of delay and cost overruns in construction of groundwater projects in sub-Saharan Africa. *International Journal of Construction Management, 1-16.*

Bhatia, S., Choudhary, A., & Jain, D. K. (2020). Analysis of road construction project cost overrun in India: A case study. *Transportation Research Procedia, 45, 905-913.*

Cao, M., Zhang, L., Hu, Y., & Li, E. (2015). An empirical analysis of project management and project success. *International Journal of Project Management, 33(2), 363-375.*

Chan, A. P., & Chan, D. W. (2014). Key performance indicators for measuring construction success. Benchmarking: *An International Journal, 11(2), 203-221.*

Diaz-Robainas, R., Li, L., & Herrera, O. E. (2019). A review of the use of building information modelling (BIM) and other intelligent approaches in construction estimation. *Applied Sciences, 9(13), 2747.*

Donaldson, L. (2001). *The Contingency Theory of Organizations*. Sage Publications.

Eisenbeiss, S. A., Knippenberg, D. V., & Boerner, S. (2020). Transformational leadership and team innovation: Integrating team climate principles. *Journal of Applied Psychology, 105(11), 1245-1258.*

Flyvbjerg, B., Holm, M. S., & Buhl, S. L. (2013). How (In)accurate Are Demand Forecasts in Public Works Projects? The Case of Transportation. *Journal of the American Planning Association, 69(4), 414-426.*

Fowler, F. J. (2013). *Survey research methods.* Sage Publications.

Gareis, R., & Huemann, M. (2013). The role of project management in achieving project success. *In Reframing Human Resource Management, Innovation and Entrepreneurship (pp. 113-124). Springer.*

Hegazy, T., & Ayed, A. (2013). Risk and uncertainty management in construction projects: Financial effectiveness evaluation model. *International Journal of Project Management, 31(6), 942-951.*

Hillson, D., & Murray-Webster, R. (2017). *Understanding and managing risk attitude*. Aldershot: Gower Publishing, Ltd.

Hsu, T. H., Lee, S. C., & Chen, Y. Y. (2014). Development of a BIM-Based Construction Site Safety Assessment System. *Journal of Civil Engineering and Management, 20(2), 239-250.*

Kaming, P. F., Olomolaiye, P. O., Holt, G. D., & Harris, F. C. (2017). Factors Influencing Construction Time and Cost Overruns on High-Rise Projects in Indonesia. *Construction Management and Economics, 15(1), 83-94.*

Karami, H., Molenaar, K. R., & Nelson, D. (2020). Factors Influencing Cost Overruns in U.S. Highway Projects. *Journal of Management in Engineering, 36(6), 04020041.*

Kerzner, H. (2013). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling (11th ed.).* John Wiley & Sons.

Miltenburg, J., Van Wee, B., & Van Der Hoorn, A. (2015). The Risky Business of Road Transport Infrastructure Projects: A Meta-Analysis of Risk Factors. *Transport Policy, 37, 177-187.*

Mnisi, T., Aigbavboa, C., & Thwala, W. D. (2019). Community involvement in infrastructure delivery: A key to project success in South Africa. *South African Journal of Economic and Management Sciences, 22(1), 1-12.*

Mugagga, F. (2017). Road Infrastructure Development and Its Environmental and Social Impacts in Africa: An Overview. *Journal of Environmental Planning and Management, 60(4), 591-611.*

Mugangu, A. A., Baawuo, D. K., & Ogunlana, S. O. (2019). Project risk assessment for infrastructure construction in developing countries: Empirical investigation in the context of road projects in Rwanda. *Journal of Construction Engineering and Management, 145(3), 04018110.*

Müller, R., & Turner, R. (2020). Leadership competency profiles of successful project managers. *International Journal of Project Management, 28(5), 437-448.*

Nsengiyumva, J. B., Nsabimana, E., & Zhang, L. (2020). Investigating the Causes and Effects of Cost Overruns on Road Construction Projects in Rwanda. *Advances in Civil Engineering, 2020, 1-13.*

Nyaribo, S. G., & Mwakisha, J. M. (2018). Cost Overrun Factors in Road Construction Projects in Kenya. *International Journal of Construction Engineering and Management, 7(2), 21-28.*

Odeck, J. (2014). Sources of cost overrun in transport infrastructure projects: A case of Norway. *Transportation Research Part A: Policy and Practice, 65, 88-95.*

Ogunlana, S. O., & Promkuntong, K. (2016). Construction Cost Overrun in Indonesia Projects: A Comparison of Government Bodies, Private Developers, and Contractors. International *Journal of Project Management, 14(2), 83-91.*

Pinto, J. K., & Mantel, S. J. (2020). The Causes of Project Failure. IEEE Transactions on *Engineering Management, 37(4), 269-276.*

PMBOK Guide. (2021). *A Guide to the Project Management Body of Knowledge (PMBOK Guide).* Project Management Institute.

Project Management Institute. (2017). *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) (6th ed.).* PMI Publications.

Rutikanga, J. V., Mwema, C. M., & Nkundabakura, P. (2020). Cost Overruns in Road Infrastructure Projects: A Case Study of Rwanda. *Journal of Construction Engineering and Management, 146(5), 04020045.*

Schwalbe, K. (2021). *Information technology project management.* Cengage Learning.

Shen, L., Fan, L., Zhang, L., & Qian, W. (2011). Factors Affecting Cost Performance: Evidence from China. *Journal of Construction Engineering and Management, 137(10), 845-855.*

Shenhar, A. J., & Dvir, D. (2018). *Reinventing project management: The diamond approach to successful growth and innovation*. Harvard Business Review Press.

Singh, S. P., & Rani, A. (2018). Cost overrun analysis of construction of national highways in India. *Journal of Infrastructure Development, 10(1), 19-35*.

Smith, N. J., & Merna, T. (2013). *Cost management in construction projects*. Routledge.

Sserwanga, A., Zayed, T., & Aigbavboa, C. (2020). A framework for assessing the capacity building needs of construction contractors in developing countries: Case of Uganda. *Journal of Engineering, Design and Technology.*

Turner, J. R. (2014). *The Handbook of Project-Based Management (4th ed.).* McGraw-Hill Education.

Turner, J. R., & Cochrane, R. A. (2013). Goals-and-methods matrix: Coping with projects with ill defined goals and/or methods of achieving them. *International Journal of Project Management, 11(2), 93-102.*

Turner, J. R., & Müller, R. (2015). The Project Manager's Leadership Style as a Success Factor on Projects: A Literature Review. *Project Management Journal, 36(2), 49-61.*

Turner, J. R., & Zolin, R. (2022). Forecasting success on large projects: Developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames. *Project Management Journal, 43(5), 87-99.*

Turner, R., & Zolin, R. (2022). Forecasting success on large projects: Developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames. *Project Management Journal, 43(5), 87-99.*

Turner, R., & Zolin, R. (2022). Forecasting success on large projects: Developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames. *Project Management Journal, 43(5), 87-99.*

Uwamahoro, J., Kang, Y., Kim, S., & Kim, S. (2018). The Impact of Project Management Practices on Project Success: *The Case of Rwanda's Infrastructure Development. Sustainability, 10(11), 3989.*

Walker, D. H. T., Dada, J. O., & Mbachu, J. I. (2019). Resource Management in Construction: A Review of Critical Issues. *Journal of Construction Engineering and Management, 145(5),*

Yuan, H., Lu, Y., Wang, S., & Skibniewski, M. J. (2018). Identifying Critical Factors Affecting Schedule Delay in Highway Projects: A Bayesian Network Approach. *Journal of Construction Engineering and Management, 144(10), 04018080.*